Title: METHOD AND APPARATUS FOR DRY-ETCHING HALF-TONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT PHOTOMASKS AND METHOD FOR THE PREPARATION THEREOF, AND SEMICONDUCTOR CIRCUITS AND METHOD FOR THE FABRICATION THEREOF Inventor: Takaei SASAKI et al Appln. No.: New Application Docket No.: 101136-00102

Fig. 1

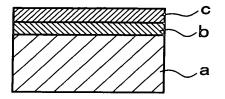


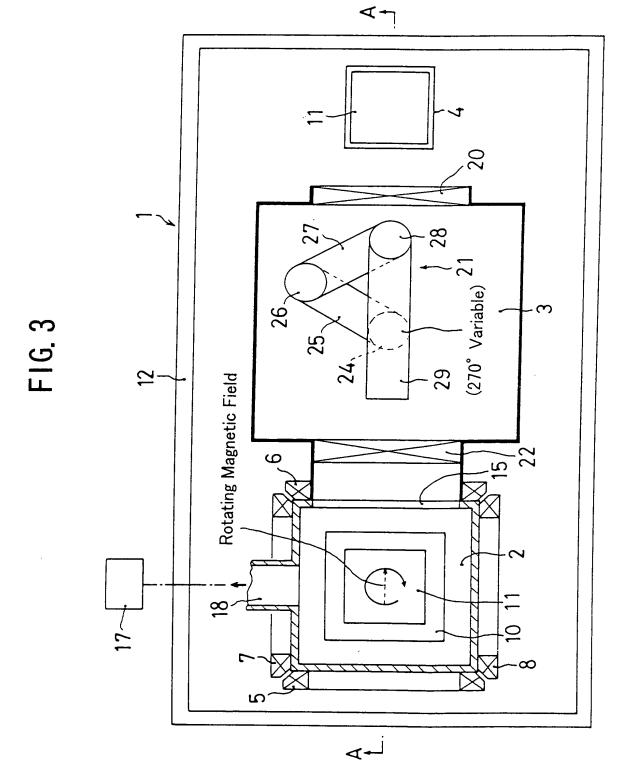
Fig. 2

Flow	Electron Beam Patterning Process	Laser Beam Patterning Process	
Receipt of Blank	·		
Exposure/Patterning	Electron Beam Patterning Device	Laser Beam Patterning Device	
	Spray, Dip, Paddle Systems		
Development	Organic Solvent Development Alkali Development	Alkali Development	
Post-Baking	Hot Plate Oven Convection Oven	Generally, any treatment is not required.	
De-scumming	Plasma De-scumming Device	Generally, any treatment is not required.	
	Wet Etching and Dry-Etching		
Removal of Resist	Solvent Pealing, Ashing	Exposure of Whole Surface/Alkali Pealing, Solvent Pealing, Ashing	
Washing	Sheet-Fed Acid-Treatmer or the like	cid-Treatment, Physical Scrubbing,	
To Inspection Step			

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THE: METHOD AND APPARATUS FOR DRY-ETCHING HALFTONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT
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## Fing. 5 A

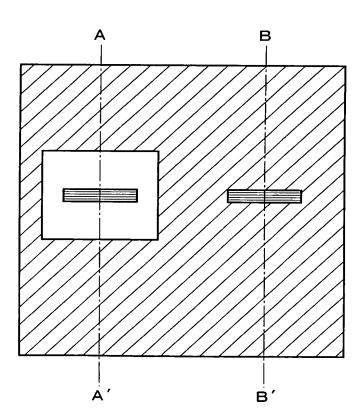
Completely Removed Pattern (Periphery of the Dimension-Evaluation Pattern)

Dimension-Evaluation Pattern (L/S, Isolated L, Isolated S)

20mm

20mm

Fing. 5B



←Dense Portion→ Coarse Portion→

TIME: METHOD AND APPARATUS FOR DRY-ETCHING HALF-TONE PHASE-SHIFT FILMS, HALF-TONE PHASE-SHIFT PHOTOMASKS AND METHOD FOR THE PREPARATION THERE-AND SEMICONDUCTOR CIRCUITS AND METHOD FOR THE FABRICATION THEREOF

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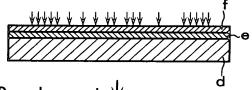
Fing. 6 A

Fing. 6 B

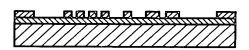
Test Pattern on Dense Portion(A-A')

Test Pattern on Coarse Portion(B-B')

(a) EB Patterning



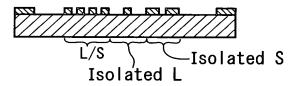
(b) Development ∜



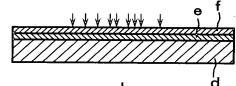
(c) Etching



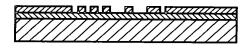
(d) Removal of Resist



(a) EB Patterning



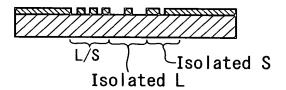
(b) Development \\ \forall \end{align\*



(c) Etching



(d) Removal of Resist



Dimensional Difference (  $\mu$  m)

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Fig. 8

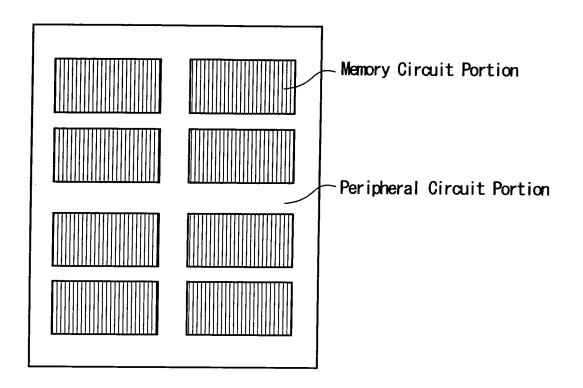
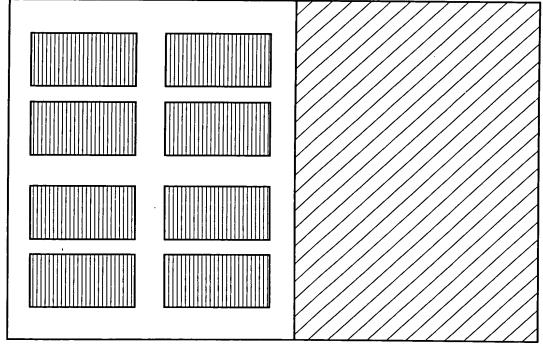


Fig. 9



Memory Circuit Portion

Logic Circuit Portion